# HISTORY OF AUSTRALIAN REINFORCING BAR STANDARDS

## Hot Rolled Plain Round Reinforcing Bars

| Std No | Period | Sizes | Mechanical Properties | Chemistry | Identification | Comments |
|---|---|---|---|---|---|---|
| A.S. A.81<br><br>Grade designations were:<br><br>Mild<br>Structural<br>Intermediate<br>Hard | 1958 - 1965 | Not Stated | **Mild Grade**<br>Yield Strength: 205 MPa min<br>Tensile Strength: 380 - 480 MPa<br>Elongation: 20% on gauge length of 200mm, but less for bar diameters above and below ¾ inch<br><br>**Structural Grade**<br>Yield Strength: 230 MPa min<br>Tensile Strength: 435 - 515 MPa<br>Elongation: 20% on gauge length of 200mm but less for bar diameters above and below ¾ inch<br><br>**Intermediate Grade**<br>Yield Strength: 275 MPa min<br>Tensile Strength: 480 - 620 MPa<br>Elongation: 16% on gauge length of 200mm, but less for bar sizes above and below ¾ inch.<br><br>**Hard Grade**<br>Yield Strength: 345 MPa min<br>Tensile Strength: 550 MPa min<br>Elongation: 10% on gauge length of 200mm, but less for bar diameters above and below ¾ inch | Only requirements were:<br>S: .06% max<br>P: .06% max<br><br>Mild and Structural grades could be assumed to have welding equivalents to structural steel (WTIA Group 4 Steel)<br><br>Intermediate grade could be assumed equivalent to WTIA Group 5 Steels<br><br>Hard Grade could be assumed equivalent to WTIA Group 6 steel | On bundle tag only covering makers name, trade mark, grade of steel, and batch number | |
| A.S. A.81 | 1965 - 1973 | Not stated, but generally in increments of 1/8 inch starting at 3/8 inch | Yield Strength: 230 MPa min<br>Tensile Strength: 305 MPa<br>Elongation: 22% min on 5d | C: .30% max<br>C + Mn/6: .45% max<br><br>As produced by BHP, equivalent to WTIA Group 4 Steel | On bundle tags only, covering heat/batch number and this Standard | |

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|---|---|---|---|---|---|---|
| AS 1302 - 230R | 1973 - 1977 | Range of diameters 10 - 50mm | Yield Strength: 230 MPa Min<br>Tensile Strength: 430 MPa min<br>Elongation: 22% min on 5d | Carbon: .30% max<br>C + Mn/6: .45% max<br><br>As produced by BHP, equivalent to WTIA Group 4 Steel | On bundle tag only covering heat / batch number and grade of steel | |
| AS 1302 - 230R | 1977 - 1982 | As above | Yield Strength: 230 MPa min<br>Tensile Strength: 1.15xYS min<br>Elongation: 22% min on 5d | As above | As above | |
| AS 1302 - 230R | 1982 - 1991 | Range of diameters 6.5 - 36mm | As above | As above | As above | |
| AS 1302 - 250R | 1991 - 2001 | As above | Yield Strength: 250 MPa min<br>Tensile Strength: 1.10xYS<br>Elongation: 22% on 5d | Carbon: .25% max<br>Carbon Equivalent defined as:<br>C + Mn/6 + (Cr + Mo + V)/5 + (Ni + Cu)/15<br>= .43% max<br><br>Equivalent to WTIA Group 4 Steel | On bundle tag only covering manufacturer, grade, this Standard, heat/batch number and mass | AS 3679 - 250 grade rounds are deemed to comply with this grade |
| AS 4671 | 2001 - | Not stated | Yield Strength: 300 MPa min<br>Tensile Strength: 440 MPa min<br>Elongation: 22% min on 5d | Carbon: .22% max<br>Carbon Equivalent defined as:<br>C + Mn/6 + (Cr + Mo + V)/5 + (Ni + Cu)/15<br>= .43% max<br><br>Equivalent to WTIA Group 4 Steel | As above | Supplied by OneSteel as 300PLUS (in accordance with AS/NZS 3679.1) |

## Hot Rolled Deformed Bar Reinforcing Steels

| Std No | Period | Sizes | Mechanical Properties | Chemistry | Identification | Comments |
|---|---|---|---|---|---|---|
| A.S. A.92<br><br>Grade designations were:<br>Mild<br>Structural<br>Intermediate<br>Hard | 1958 - 1965 | Bar numbers 3 to 11 where each unit represents 1/8 inch.<br>Effective range 10mm - 35mm | **Mild Grade**<br>Yield Strength: 205 MPa min<br>Tensile Strength: 380 - 480 MPa<br>Elongation: 20% on gauge length of 200mm, but less for bar diameters above and below ¾ inch<br>**Structural Grade**<br>Yield Strength: 230 MPa min<br>Tensile Strength: 435 - 515 MPa<br>Elongation: 20% on gauge length of 200mm but less for bar diameters above and below ¾ inch<br>**Intermediate Grade**<br>Yield Strength: 275 MPa min<br>Tensile Strength: 480 - 620 MPa<br>Elongation: 16% on gauge length of 200mm, but less for bar sizes above and below ¾ inch.<br>**Hard Grade**<br>Yield Strength: 345 MPa min<br>Tensile Strength: 550 MPa min<br>Elongation: 10% on gauge length of 200mm, but less for bar diameters above and below ¾ inch | Only requirements were:<br>S: .06% max<br>P: .06% max<br><br>Mild and Structural grades could be assumed to have welding equivalents to structural steel (WTIA Group 4 Steel)<br><br>Intermediate grade could be assumed equivalent to WTIA Group 5 Steels<br><br>Hard Grade could be assumed equivalent to WTIA Group 6 steel | On bundle tag only covering makers name, trade mark, grade of steel, and batch number | |
| A.S. A.92 | 1965 - 1973 | As above | **Structural Grade**<br>Yield Strength: 230 MPa min<br>Tensile Strength: 430 MPa min<br>Elongation: 22% min on 5d<br><br>**Hard Grade**<br>Yield Strength: 345 MPa min<br>Tensile Strength: 550 MPa<br>Elongation: 14% min on 5d | C: .30% max<br>C + Mn/6: .45% max<br><br>As produced by BHP, equivalent to WTIA Group 4 Steel | On bundle tags only, covering heat/batch number and this Standard. Hard grade to have identification marks at manufacturer's discretion on opposite sides of bar. This was typically an additional short longitudinal rib joining two transverse ribs | |

| Std No | Period | Sizes | Mechanical Properties | Chemistry | Identification | Comments |
|---|---|---|---|---|---|---|
| AS 1302 – 230S | 1973 – 1977 | Not stated | Yield Strength: 230 MPa min<br>Tensile Strength: 430 MPa min<br>Elongation: 22% on 5d | Carbon: .30% max<br>C + Mn/6: .45% max<br><br>As produced by BHP, equivalent to WTIA Group 4 steel | On bundle tags only, covering heat/batch number and grade. | |
| AS 1302 | 1977 - 1982 | 12mm to 36mm in 4mm increments. 40mm and 50mm subject to enquiry. | **Grade 230S**<br>Yield Strength: 230 MPa min<br>Tensile Strength: 1.15 x YS min<br>Elongation: 22% on 5d<br><br>**Grade 410Y**<br>Yield Strength: 410 MPa min<br>Tensile Strength: 1.15 x YS<br>Elongation: 12% min on 5d | **Grade 230S**<br>Carbon: .30 max<br>C + Mn/6: .45% max<br><br>As produced by BHP, equivalent to WTIA Group 4 Steel<br><br>**Grade 410Y**<br>Carbon: .35% max<br>C + Mn/6 = .60% max<br><br>As produced by BHP, equivalent to WTIA Group 4 Steel | On bundle tag covering manufacturer, grade, this Standard, heat/batch number and mass.<br><br>For grade 410Y only, a continuous mark on diametrically opposite surfaces of the bar. | There was no large scale production of grade 410Y in this period |
| AS 1302 | 1982 - 1991 | 12mm to 36mm in 4mm increments. 40mm and 50mm subject to enquiry. | **Grade 230S**<br>Yield Strength: 230 MPa min<br>Tensile Strength: 1.15 x YS min<br>Elongation: 22% on 5d<br><br>**Grade 410Y**<br>Yield Strength: 410 MPa min<br>Tensile Strength: 1.05 x YS<br>Elongation: 12% min on 5d | **Grade 230S**<br>Carbon: .30 max<br>C + Mn/6: .45% max<br><br>**Grade 410Y**<br>Carbon: .35% max<br>C + Mn/6 = .60% max<br><br>As produced by BHP, equivalent to WTIA Group 4 Steel | On bundle tag only covering heat / batch number and grade of steel. | This marked the introduction of TEMPCORE steel, and the rapid phasing out of cold twisted rebars |

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|---|---|---|---|---|---|---|
| AS 1302 | Amdt 1983 | As above | As above | Carbon: .22% max<br>Carbon Equivalent defined as:<br>C + Mn/6 + (Cr + Mo + V)/5 + (Ni + Cu)/15 = .39% max | A distinctive deformation pattern or other markings to identify grade. This resulted in use of the still current crescent shaped transverse ribs and the name "TEMPCORE" on BHP bars. This was later modified to show individual producing mill ID marks. | |
| AS 1302 | 1991 - 2001 | 12mm to 36mm in 4mm increments. 40mm and 50mm subject to enquiry. | **Grade 250S**<br>Yield Strength: 250 MPa min<br>Tensile Strength: 1.10 x YS min<br>Elongation: 22% on 5d<br><br>**Grade 400Y**<br>Yield Strength: 400 MPa min<br>Tensile Strength: 1.10 x YS<br>Elongation: 16% min on 5d | **Grade 250S**<br>Carbon: .25% max<br>Carbon Equivalent defined as:<br>C + Mn/6 + (Cr + Mo + V)/5 + (Ni + Cu)/15 = .43% max<br><br>Equivalent to WTIA Group 4 Steel<br>**Grade 400Y**<br>Carbon: .22% max<br>Carbon Equivalent defined as:<br>C + Mn/6 + (Cr + Mo + V)/5 + (Ni + Cu)/15 = .39% max | On bundle tag only covering manufacturer, grade, this Standard, heat/batch number and mass.<br>Bar markings at manufacturers discretion to identify grade of steel and producing mill - see TEMPCORE information. | |

| Std No | Period | Sizes | Mechanical Properties | Chemistry | Identification | Comments |
|---|---|---|---|---|---|---|
| AS 4671 | 2001 - | 12, 16, 20, 24, 32, 36mm 10mm also available in coil. 40mm also available in bar. | **Grade 250N**<br>Yield Strength: 250 MPa as lower characteristic value.<br>Tensile Strength: 1.08 x YS<br>Elongation at maximum force (Uniform elongation or Agt): 5%<br><br>**Grade 500N**<br>Yield Strength: 500 MPa as lower characteristic value.<br>650 MPa as upper characteristic value<br>Tensile Strength: 1.08 x YS<br>Elongation at maximum force (Uniform elongation or Agt): 5% | **Grade 250N**<br>Carbon: .22% max<br>Carbon Equivalent defined as:<br>C + Mn/6 + (Cr + Mo + V)/5 + (Ni + Cu)/15 = .43% max.<br>Equivalent to WTIA Group 4 Steel<br><br>**Grade 500N**<br>Carbon: .22% max<br>Carbon Equivalent defined as:<br>C + Mn/6 + (Cr + Mo + V)/5 + (Ni + Cu)/15 = .44% max.<br>Equivalent to WTIA Group 4 Steel | Two or more longitudinal marks in addition to longitudinal ribs, or a minimum of two short transverse markings, or alpha numeric characters indicating steel grade | |

## Cold Twisted Deformed Bar Reinforcing Steels

| Standard | Period | Sizes | Mechanical Properties | Chemistry | Identification | Comments |
|---|---|---|---|---|---|---|
| A.S. A.83 | 1958 - 1966 | Not Specified | For single bars > 10mm (3/8 inch) diameter.<br>Proof Stress: 410 MPa<br>Tensile Strength: 480 MPa<br>Elongation: 14% min on 8d<br>: 16% min on 4d<br><br>For twin bars > 10mm (3/8 inch) twisted together:<br>Proof Stress: 370 MPa<br>Tensile Strength: 435 MPa<br>Elongation: 14% min on 8d<br>16% min on 4d | Only requirements were:<br>S: .06% max<br>P: .06% max<br><br>As produced by BHP, equivalent to WTIA Group 4 Steel | At manufacturer's discretion. | |
| AS A83 | 1966 - 1973 | Not restricted but expressed in bar numbers where each unit represents 1/8 inch of diameter. | For bar sizes #3 and above (10mm and above)<br>Proof Stress: 410 MPa<br>Tensile Strength: 480 MPa<br>Elongation: 14% min on 5d | C: .30% max<br>C + Mn/6: .45% max<br><br>As produced by BHP, equivalent to WTIA Group 4 Steel | Marked or tagged to identify conformance with this specification | Square twisted rebars also covered by this specification. This grade was sometimes referred to as "CW60" indicating cold twisted bar with 60 kips minimum yield strength |
| AS 1302 | 1973 - 1977 | 10mm and then in 4mm increments to 36mm. | Proof Stress: 410 MPa min<br>Tensile Strength: 480 MPa min<br>Elongation: 14% min on 5d | C: .30% max<br>C + Mn/6: .45% max<br><br>As produced by BHP, equivalent to WTIA Group 4 Steel | On bundle tag only covering heat / batch number and grade of steel | |

| Standard | Period | Sizes | Properties | Chemistry | Identification | Comments |
|---|---|---|---|---|---|---|
| AS 1302 | 1977 - 1982 | 12mm to 36mm in 4mm increments | Proof Stress: 410 MPa min<br>Tensile Strength: 1.08 x PS<br>Elongation: 12% min on 5d | C: .30% max<br>C + Mn/6: .45% max<br><br>As produced by BHP, equivalent to WTIA Group 4 Steel | Marked or tagged to identify conformance with this specification, and heat/batch number | |
| AS 1302 | 1982 - 1991 | 12mm to 36mm in 4mm increments | Proof Stress: 410 MPa min<br>Tensile Strength: 1.05 x PS<br>Elongation: 12% min on 5d | C: .30% max<br>C + Mn/6: .45% max<br><br>As produced by BHP, equivalent to WTIA Group 4 Steel | Marked or tagged to identify conformance with this specification, and heat/batch number | Cold twisted bars were not made in Australia beyond 1983 |

## Deformation Requirements and Dimensions.

The basic requirements for rib design, spacing, height and coverage have remained essentially unaltered since 1958. These requirements are similar to those for other major international Reinforcing Bar Standards. The current standard (AS/NZS 4671:2001) includes a requirement to determine the specific projected area of ribs as a means of demonstrating that the required bond with concrete will be achieved.

## Hard Drawn Wire and Mesh

The material properties of hard drawn wire, and reinforcing mesh made from this wire, remained basically unaltered from 1958 until the 1990's, being:

Proof Stress: 450 MPa min
Tensile Strength: 500 MPa min.

During the 1990's, higher strength deformed wires were produced with strengths of:

Proof Stress: 500 MPa min
Tensile Strength: 550 MPa min.

The nominal sizes of these higher strength wires were proportionally reduced in line with the increase in strength.

With the publication of AS/NZS 4671 in 2001, reinforcing wire and mesh must achieve a proof stress of 500 MPa as a lower characteristic value. In addition, these products must satisfy the following ductility measures:

Ratio ($R_m/R_e$): 1.03 min
Uniform Elongation ($A_{gt}$): 1.5 % min.

## Material Identification

Should you need to identify reinforcing steels where the origin, grade and strength levels are unknown, we can provide a very accurate estimate of properties and likely specification. Simply cut a sample of length 25mm or greater. A longer sample would be preferable if heat (eg from oxy cutting of sample) has been applied. We will determine an estimate of properties based on our chemical analysis, microstructure assessment and hardness level in the sample provided.

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